

# GOME-2 FLOURESCENCE README FILE

## Overview

This document presents a brief description of the GOME2\_F data products. These are experimental research products produced by PI Joanna Joiner on a best effort basis. GOME2\_F version 26 (V26) retrievals from the GOME-2 instrument on MetOp-A and -B use channel 4 with  $\sim 0.5$  nm spectral resolution and wavelengths between 734 and 758 nm (a smaller fitting window than that presented in Joiner *et al.*, 2013). Other changes have been made to the algorithm since Joiner *et al.*, 2013 (see Joiner *et al.*, 2014, 2016). V27 is a new post-processing of V26 level 2 retrievals to provide additional fields and improved bias corrections and calibration. Contact the PI for more details. Data from both MetOp-A and –B are now being processed on a regular basis. Monthly data should be available shortly after the end of a month. MetOp-B files are designated by having ‘MOB’ in the filenames.

## Data Quality Assessment

GOME-2\_F products are inherently noisy due to low signal levels. Users should expect to see negative values in both level 2 and level 3 data sets. When using level 2 data sets, users should retain those negative values and treat them like they would for any other noisy data set. For example, if fluorescence is zero, there should be a distribution of measurements centered about zero including negative

values. Any attempts to remove negative values or force them to zero for the purpose of averaging will then bias results. Level 3 data are monthly gridded averages, yet still there are some negative values owing to imperfect bias correction, noise, etc. Users may treat the negative monthly values as zero for certain applications. However, in other applications, such as averaging over a number of years, the negative values should be retained.

Users should be aware that the GOME-2 data sets provided here have undergone only a limited amount of validation (e.g., Yang et al., 2015). Output of far-red retrievals has been compared with the filling-in signal near 758 from the GOSAT TANSO-FTS instrument that is derived from a simpler algorithm (Joiner *et al.*, 2013).

#### Known Algorithm Features:

- 1) Month to month (temporal) variations may incorporate instrumental and algorithmic effects.
- 2) The level 2 data have had various filtering applied. In particular, a screening for cloud contamination is applied (only data with effective cloud fractions of < 30% have been retained). The GOME-2 instruments have a relatively large footprint (approximately 40 km x 80 km at nadir for MetOp-B and MetOp-A before 15 July 2013 and 40 km x 40 km for MetOp-A since 15 July 2013). Therefore, clouds and aerosol are present in nearly every observation. Although our retrieval

approach can tolerate a small amount of cloud contamination, clouds will screen the surface signal from satellite view. Therefore, temporal and spatial variations in the data may also be due to cloud contamination. The cloud filtering approach is described in Joiner *et al.* (2012). For a more complete description of the errors, please see Joiner *et al.* (2013). Users may wish to apply additional cloud screening using the cloud fraction data field depending upon their application.

- 3) Some issues with data at very high solar zenith angles (in winter at high latitudes) have been noted (fluorescence is slightly positive or negative when it is expected to be zero).
- 4) Level 3 data have had various filtering applied but include cloud-contaminated data (cloud fractions of up to 30% are included). Please check for updates as we expect to improve the gridding to account for known sources of error.
- 5) There has been not attempt as of yet to reconcile the differences between MetOp-A and –B. There is a difference in calibration that causes a difference between the two data sets. Users are advised to proceed with caution if both data sets are used together. Analysis of both data sets is ongoing; the data are provided on an ‘as is’ best effort basis.
- 6) V26: SIF values are sensitive to absolute calibration of the solar irradiances. The GOME-2 instrument degraded significantly during its lifetime, particularly in the early part of the record. We have attempted to account for this by monitoring the degradation of solar

irradiance values (Joiner et al. 2016). However, the adjustments made to the data are likely imperfect. We therefore do not recommend use of these data for long-term trend analysis. No adjustments based on the solar data are applied to MetOp-B data as degradation appears to be much smaller.

- 7) V26: values are provided over ocean for monitoring of biases. We have attempted to correct for small zero-level offset problem in previous versions (Joiner et al., 2016). We now provide both the corrected and uncorrected SIF\_740 data fields. The uncorrected values are very similar to v25, though not identical as small changes were made to the principle component analysis. As the bias correction is not perfect, small biases still remain, particularly over high albedo (high radiance), non-vegetated surfaces such as the Sahara desert.
- 8) V26 Red SIF files (note: all others are far-red SIF). Use with caution as these have not undergone much evaluation. They are being provided only up through the end of 2015. See Joiner et al. (2016) for more details.
- 9) V27: Improved calibration using GOME-2 solar spectra for both MetOp-A and B (changes can be up to ~5% in absolute magnitude, depending on the date)
- 10) \*\*\*NEW FOR V27: All level 2 pixels are now provided in level 2 files with an addition quality flag so that users have more flexibility in doing their own gridded or averaging with different amounts of

- cloudiness, etc. Users of this data will now have to check the quality flag to filter out bad data
- 11) Bias adjustment has been improved in V27 resulting in less discontinuities (changes are small)
  - 12) For level 3 gridded data, we use an unweighted scheme for V27 (changes are small)
  - 13) \*\*\*NEW FOR V27: Estimated daily-averaged SIF values based on a single observation are provided. The estimates use an approximate clear sky PAR proxy (cosine of the solar zenith angle) at the observation time and a similar clear-sky PAR weighting for all other hours. This is similar to what is provided in other data sets.
  - 14) Pixel corners in L2 files are not correct and should not be used.

## Product Description

The GOME2\_F level 2 product is written as a self-describing netCDF level 2 orbital file for the day and orbit specified in the filename. A simple IDL reader has been provided. The information provided on these files includes: Latitude, longitude, SIF (SIF\_740) referenced to 740 nm, and reflectance near 670 and 780 nm.

The GOME2\_F level 3 product is written as a self-describing netCDF level 3 monthly gridded file for the month and year specified in the filename. A simple IDL reader has been provided. The information provided on

these files includes: Latitude, longitude, counts, SIF (SIF\_740) referenced to 740 nm (mean and standard deviation), and NDVI derived from 670 and 780 nm (mean and standard deviation). Note that the NDVI is cloud contaminated and no attempt has been made to apply atmospheric correction. This field is given for a rough reference and convenience only and it is not meant to be used for scientific investigations. The level 3 data sets contain only the corrected data.

## **Contact**

All questions related to the GOME2\_F datasets should be directed to Joanna Joiner ([Joanna.Joiner@nasa.gov](mailto:Joanna.Joiner@nasa.gov)), the PI of this project. The PI requests to be contacted regarding studies that utilize the data provided on this website as these are relatively new data sets that have not undergone much validation and detailed knowledge of data issues may be important to the scientific use of these data. Regular updates to this README file will be posted based on user questions and feedback.

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